SOME LARGE NORTH CAROLINA IRRIGATORS: A SURVEY OF SELECTED NURSERY, ORCHARD, TRUCK CROP AND OTHER IRRIGATORS

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A Survey of Selected Nursery,
Orchard, Truck Crop and
Other Irrigators

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A final report in this series is also planned for publication during 1966, and possibly one other Paper.

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Introduction

In 1963 the Institute of Government published eleven brief monographs in the series, "U.N.C. Water Resource Papers," on the subject of farm irrigation. Ten of these (Papers 3-12) contained the results of county-wide surveys of irrigation in three Mountain counties, five central and northern Piedmont counties, and three Tidewater and Coastal Plains counties. The other monograph, No. 2, summarized and evaluated the individual county surveys.

As indicated in these earlier studies, irrigation in North Carolina is only 10-15 years old. It is used mainly to supplement rainfall, but also (with certain crops) for frost and freeze protection, crop cooling, and plant beds. Because of soil and terrain conditions, sprinkler-type irrigation is predominant. For reasons of economy, irrigation in North Carolina is concentrated on a few intensively cultivated money crops--primarily tobacco, but also nurseries, flowers, orchards, small fruits and truck crops. Where other crops such as pasture, cotton, peanuts or corn are irrigated, this is largely incidental to the use of a system for tobacco.

The monographs previously published gave some approximations of water use per acre on various crops and described the principal sources of water that are in use. Although early irrigators in this state relied largely on rivers and streams, today the farm pond is the most common source of water. In the Coastal Plain region excavated or dug ponds, drawing on ground water reserves, predominate. Elsewhere, ponds are usually derived from either surface drainage ("surface ponds") or flowing sources, such as branches, springs or streams ("continuous flow ponds"). These distinctions have legal significance, since the rules of law respecting rights to use ground water, surface drainage, and flowing streams are not uniform.

It is anticipated that another publication in this series will be forthcoming this spring concerning irrigation trends and projections. This will focus on tobacco, which today is by far the leading irrigated

crop of North Carolina. Also to be issued in 1966 is a publication concerning irrigation hydrology.

* * * * * * *

The present monograph is built around the results of field studies conducted by James Martin in 1963 following the completion of the earlier county-wide surveys. These 1963 studies had three main objectives. First, we sought to develop some elementary background information concerning the nature and extent of irrigation of several crops which, after tobacco, are reputed to be the leading irrigated crops of North Carolina--orchards, truck crops, and nurseries. Next, with help from Agricultural Extension and Soil Conservation officials, we identified and interviewed some of North Carolina's largest individual irrigators without regard to crop or location considerations. Our findings in this regard are reported in the section headed, "Special Situations." We also interviewed a small sample of irrigators who reportedly secured permits under a now defunct irrigation permit law, in order to explore some unresolved questions concerning these permits. This monograph also includes the results of a mail questionnaire sent to nurserymen by Milton Heath in early 1966.

The studies reported in this and the earlier monographs are not analyses in depth nor comprehensive surveys of the total irrigation picture. They represent merely a beginning effort at filling a large existing gap in information concerning irrigation practices. We hope that they will stimulate others to undertake the more rigorous analyses that are needed for a better understanding of present and prospective irrigational water use in North Carolina.

One precautionary note should be added concerning the acreages of individual irrigators indicated in this monograph. While the acreages listed should be reasonably accurate as of the date of our interviews with particular irrigators, we have not systematically recontacted the irrigators. In many cases, three to four years have intervened since the initial contacts. Scattered information from a few individuals leads us to believe that some change in acreages under irrigation is to be expected during such a period.

Apples

Apples are the state's leading orchard and fruit crop, and in 1963 North Carolina was the eleventh ranking apple producing state in the union. 1963 North Carolina apple production totalled about 2.6 million bushels, and its value was almost $5,700,000 or about one-half of 1% of the value of all farm commodities in the State. In 1965 the State ranked eighth among apple producing states, with a production of 4.2 million bushels and a preliminary value estimate of over $6,500,000.[1]

There are several principal apple production centers in the state, located in the Mountain and Western Piedmont sections. These centers are normally referred to as Hendersonville (Henderson, Buncombe and Polk Counties); Wilkes-Alexander; Mt. Mitchell area; Haywood (including Jackson and Macon Counties as well as Haywood); and Cleveland-Lincoln-Gaston (including also Burke and Catawba Counties).

The field surveys reported here on apple orchard irrigation were made in the summer of 1963 in Henderson County, the largest single apple producing county in the state. There were then reported to be approximately 400 apple growers in Henderson County. An estimated thirty to forty of these were large operators with 75 acres or more in apples. No more than ten of these orchardists were believed to practice irrigation, and only five irrigators were identified in our survey. Three of the five irrigated orchards were located along a ridge where rainfall averages about 40" annually or two-thirds of the 60" county-wide average.

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[1] The primary sources for crop production statistics in this Paper are: 1963 and 1964 N. C. Agricultural Statistics; Farm Income State Estimates 1949-1963 and 1949-1964, Supplements August 1964 and August 1965; data on ranking of North Carolina as producer supplied by N. C. State University, Extension Service Farm Management. In most cases 1963 and 1964 statistics are relatively uniform, and 1963 statistics only are used. Where there is any significant variation this fact is noted.

In the case of apples and peaches, additional data covering 1965 production is derived from three publications of the North Carolina Department of Agriculture: North Carolina Farm Report, no. 446 (Dec. 30, 1965); North Carolina Commercial Peach Survey (1965); North Carolina Commercial Apple Orchard Survey (1966).

Orchard irrigation in Henderson County is apparently of such recent origin that it can almost be termed "experimental." Among the orchardists we interviewed, the earliest irrigation began in 1957 and it has been practiced periodically since that time, depending on rainfall conditions. One factor at work possibly favoring growth of orchard irrigation here is a potential shift from truck crops to apples in the county, owing to adverse recent experience in truck farming. The prevalence of young non-bearing trees was quite apparent. This growth potential is indicative also of conditions prevailing in the North Carolina apple economy generally. Based on present plantings of young trees, a doubling of current apple production is predicted by 1971.

Another condition that could be favorable to increased irrigation would be increased use of newer dwarf apple tree varieties. Irrigation is thought to be more promising for dwarf trees than for the older full-sized varieties because the dwarf trees, having smaller root systems, are more susceptible to dry weather damage. In North Carolina, although size control of trees is often practiced, the use of dwarf varieties is thus far negligible. Size control might be favorable to increased irrigation in another way, by leading to closer plantings and increased water needs.

There was some indication of potential competition among irrigators for water supply in one situation in Henderson County, but it was thought that conflict could be avoided by providing adequate storage.

In an effort to supply a check upon the prospects of orchard irrigation in North Carolina, we made inquiries of a few selected orchardists in Virginia. It was our thought that this more developed apple growing region might provide some clues as to the likelihood of increased irrigation in the future in North Carolina orchards. From the limited responses to our inquiries, it appears unlikely that orchard irrigation is practiced on a much larger scale among the Virginia growers than among the North Carolina growers.

Apple growers may irrigate for several reasons, including frost and freeze protection, crop quality improvement and drought protection for the trees. Irrigation is used for frost and freeze protection in early spring or late winter after blossoms have formed when frost or freezing

temperature can destroy a crop. It is thought that frost damage can occur at air temperatures as high as 38°F. if the air is still. Other alternatives to irrigation--such as smudge pots, or giant windmills sometimes used by Florida citrus growers--are sometimes considered preferable to fight frost and freeze damage. This is because irrigation as a means of frost and freeze protection may be a double-edged weapon. If the temperatures fall drastically and winds rise following irrigation, the combined action of wind, water and low temperatures may create a supercooling effect, resulting in a hard freeze that intensifies damage.

The apple orchard irrigators we contacted applied water to their orchards at annual rates ranging from 2" to 9", in one to three settings, and to acreages ranging from 30 to 200 acres. From our observation the 9" rate appeared to be more representative than the 2" rate of what might be expected if commercial irrigation of apples were ever established on a large scale in North Carolina. The sources of irrigation water used were ponds and streams.

Peaches

Peaches are North Carolina's second ranking orchard and fruit crop, behind apples. North Carolina was the seventh ranking peach producing state in the union in 1963. North Carolina peach production in 1963 totalled about 1.5 million bushels. 1963 peach production was valued at almost $3.6 million, or .3 of 1% of the value of all farm commodities. (1964 production fell to less than one-third of the 1963 total because of freezing weather. 1965 production returned to approximately its 1963 level, though with a lower value.)

Peaches are grown largely in the Sandhill section of the state, centering in Montgomery, Moore and Richmond Counties. Our information relating to peach orchard irrigation is limited to these three counties and was obtained by questionnaires addressed to the County Extension Chairmen and SCS Work Unit Conservationists in the summer of 1963. No field trips were made.

The answers to our questionnaires were as follows:

*In one county (Richmond) the average peach orchard was 100 acres, and in the other two counties about 50 acres, although in Montgomery about ten orchards were substantially larger and made up about half the acreage.

*Ten to twelve orchards were irrigated in 1963 in both Moore and Montgomery Counties; only one in Richmond.

*Most of the orchardists also raise tobacco, and most (though not all) of the orchard irrigators purchased their irrigation systems primarily for tobacco.

*The general impression seemed to be that orchard irrigation was not on the increase, and would not expand at least until some chronic problems of the peach growers were solved. One reason suggested for the lack of irrigation expansion prospects was that early varieties, the ones most benefited by irrigation, are declining in this area.

*Although a few growers had bought "big gun" sprinkler systems, there was no disposition to think that this equipment would bring about any significant expansion in orchard irrigation.

Truck Crops

Vegetable production is a substantial contributor to farm income in North Carolina. Value of all 1963 vegetable produce in the state was $32,573,000 or 2.7% of the total value of all farm commodities. Of this amount sweet potatoes accounted for over $7.5 million; white potatoes, snap beans and cucumbers each for $3.5 to $4.6 million; and cabbage, tomatoes, peppers and sweet corn each for $1.1 to $2.3 millions. (The 1964 total was substantially higher, $37,629,000, or 3% of total commodity value.)

North Carolina in 1963 was the largest producer among all the states of sweet potatoes; it also ranked from fourth to ninth in cucumber, pepper, cabbage, snap bean, lima bean, cantaloupe and beet production (income from sale). Truck farming is distributed throughout the state, with concentrations in some areas (mainly eastern and far western). Estimated 1963 commercial vegetable acreages for major truck crops were as follows:

Snap beans, late spring	4,000	Snap beans, late summer	5,700
Snap beans, early fall	600	Snap beans, processing	2,400
Cabbages, late spring	2,200	Cabbages, late summer	3,400
Cabbages, late fall	2,400	Lettuce, early spring	350
Tomatoes, early summer	2,100	Tomatoes, late summer	1,000
Cucumbers, late spring	4,700	Cucumbers, processing	20,100
Lima beans, summer	1,300	Beets, spring	150
Sweet corn, early summer	4,200	Onions, late spring	250
Cantaloupes, mid summer	2,700	Watermelons, early summer	8,700
Strawberries, mid spring	2,000	Green peppers, early summer	5,500

TOTAL . . . . . 73,750 acres

The surveys we made of truck crop irrigation were conducted in the summer of 1963 and constituted a very limited sample of truck farmers in the state. Perhaps the most striking feature encountered was the variety of results.

We attempted a comprehensive survey of truck crop irrigation in only one county, Sampson. Although this county was selected for intensive consideration because of reputedly extensive truck irrigation, our findings indicated only negligible irrigation. Even those farmers having irrigation systems indicated that their use was primarily for tobacco and only incidentally for truck crops. We were referred to some 25 farmers as likely to irrigate truck crops. Of this number 17 were located, 12 of whom professed to irrigate truck crops. Nine of them had irrigated in 1963, a total of 94 acres, with only 49 acres generally irrigated during the season. One-fifth of the county's annual farm income, or about $8 million, was estimated to come from truck crops. It seems apparent that the 50-100 acres of irrigated truck crops can only have played a minor role in this county's truck crop production.

Another county where substantial truck irrigation was anticipated but only negligible irrigation actually encountered was Pasquotank. In the words of the County Extension Chairman, irrigation here had "come and gone." Where 8 or 10 large irrigators were operating a few years earlier, systems were now being maintained only as insurance and used but rarely, in occasional dry spells. Part of the irrigation shrinkage was apparently due to a general decline in truck farming. (We encountered similar conditions in Henderson County, where truck farming acreage of 12,000-15,000 acres had been cut in half within a seven-year period as a result of a combination of adverse conditions. Irrigation had apparently undergone a comparable or larger reduction.)

In contrast is the situation we found in a tomato growing center located in two neighboring communities of Rowan County. One farmer was interviewed here who irrigated nearly 20 acres of tomatoes, about a fourth of the total community acreage. Irrigation begins around April 20 and continues throughout the season until frost (late October or early November). Irrigation is practiced at weekly intervals, with 1" per setting until June 20 and 1 1/2" thereafter--a possible annual total of as much as 38". In the very early and very late portions of the season irrigation is used for frost and freeze protection; otherwise its purpose is quality improvement and drought protection.

Another impressive truck crop irrigation situation was found at the Caledonia Prison Farm in Halifax County--probably North Carolina's largest truck irrigation operation and one of the two or three most substantial irrigation programs of any kind in the state. A further exceptional feature of the Caledonia situation is that furrow or ditch irrigation is practiced here as well as the usual sprinkler method--one of a very few such situations encountered in the state. Altogether some 700 acres of truck crops were irrigated at this farm in 1963, with an average application of 1 1/2"-4" of water. For further details on Caledonia, see "Special Situations," below.

Nurseries

The Division of Entomology of the North Carolina Department of Agriculture inspects and certifies plant nurseries for pest control. An annual pamphlet published by the Division, Certified Nurseries of North Carolina, lists all the nurseries in the State, by size and type.

The 1965-66 edition of Certified Nurseries, and its supplement, show a total of almost 1,100 nurseries in the State. Several points stand out regarding nursery locations:

. . . Nurseries are fairly well spread through the state, being found in all but 13 counties. And only two counties have unusually large numbers of establishments, Avery with over 100 and Swain with 50.

. . . Over half of the state's nurseries are located in 25 counties with 10 to 49 establishments each.

. . . Heaviest concentrations of nurseries are found in the West, the Piedmont Crescent and the Southeast.

The vast majority of the nurseries in North Carolina are quite small. 90% of the listed establishments are under 5 acres and 99% are under 50 acres.

There is a fairly close correlation between concentration of numbers of establishments and location of large establishments. Eight counties have two nurseries each larger than 20 acres, and five of these eight counties also have 10 or more establishments. Half of the 24 counties which have a nursery larger than 20 acres also have over 10 nursery establishments.

Nursery stock are classifed by Certified Nurseries in six major categories: general, ornamental, boxwood, native plant, native collected plant, and field bulbous. Occasional nurseries not falling in one of these groups are specifically identified--e.g., greenhouse, forest seedlings, potted plants, daylilies, etc. Currently over 70% of the certified nurseries in the state are classified as either ornamental, boxwood, native plant, or native collected plant--or some combination of these. Over 35% are "ornamental" only and over 17% are "boxwood" only.

Irrigation questionnaire

We developed a single questionnaire concerning irrigation practices for mailing to a selected group of nurserymen. The questionnaire sought information concerning irrigation facilities, source of water, amount of water used, types of nursery stock irrigated, future expansion plans, and legal aspects. It was mailed in March 1966 to all nurseries listed in Certified Nurseries as larger than 19 acres (a total of 27, plus two previously interviewed). It was also mailed to a random sample of other nurseries, designed to reach: (a) at least 10% of the nurseries in the 5-19 acre size group; (b) at least 5% of the nurseries in the 2-4 acre group and 1-acre-or-less group; and (c) at least 5% each of the major nursery stock types (ornamental, boxwood, native plant and native collected plant).

Over 90 questionnaires were mailed. Several weeks after the original mailing, reminders were sent to nurserymen who had not responded. Almost 70% of the mailed questionnaires were ultimately answered. The percentage

of responses ranged by size groups from around 40% for the smallest nurseries to over 85% from the largest nurseries. The results of the questionnaires are tabulated in Tables 1 and 2.

* * * * * * *

Up to this point, using the terminology of Certified Nurseries, we have lumped together all of the nursery establishments regardless of size. However, we feel there are reasons to distinguish the large and medium-sized commercial nurseries from the more numerous very small establishments. Many of the small establishments appear to be more in the nature of hobbies or part-time income supplements than commercial nurseries. Also, inclusion of the smaller nurseries in our tabulations significantly affects some categories of our results, such as type of nursery stock and geographic location. For these reasons we will present separately the survey results for the smallest establishments and for the medium and large sized nurseries. We have arbitrarily selected one acre as a convenient dividing line between the two groups.

Nurseries over 1 acre in size

Over-all results.--Answers were received covering 48 establishments larger than one acre. 33 of these establishments irrigate (69%) while 15 do not irrigate (31%). The results of our survey suggest that nursery irrigation is closely related to factors of size and location, as well as type of nursery stock. (See Tables 1 and 2, pp. 13-14.)

In tabulating the survey we included in the "non-irrigator" category not only nurserymen who never irrigate but also those who very rarely have irrigated or who use only minimal amounts of water (as in setting plants).

Size.--The strongest trend reflected by the survey is a close correlation of nursery size and irrigation. Almost all of the large nurseries (82%) irrigate, and if the gladiolus and bulb growers are eliminated the percentage of these irrigators rises about 90%. Between 55 and 60% of the 1-19 acre size group irrigates. And, as we point out later, very few of the establishments smaller than one acre irrigates.

Location.--Our survey suggests that Eastern and Piedmont nurserymen are somewhat more likely to irrigate than Western nurserymen. The percentage of irrigators among our respondents, by region, was: Piedmont 87%, East 79%, and West 45%.

A similar relationship holds among the large irrigators. 10 of the large irrigators (20 acres or more) are located in the East, 7 in the Piedmont, and 5 in the West. Three counties, one located in each region, have two large irrigating nurseries each: Avery, Mecklenburg and Pender. Counties containing one large irrigating nursery each are Brunswick, Burke, Cumberland, Edgecombe, Forsyth, Guilford, Henderson, Johnston, Montgomery, Moore, New Hanover, Randolph, Robeson, Sampson, Transylvania and Wayne.

Also 34% of all reporting irrigators are from the East; 41% from the Piedmont and 25% from the West.

Type.--The survey suggests that ornamental nurseries are more likely to irrigate than the other principal classes of nurseries, and that this group supplies the largest number of irrigators (by type) in the State. 80% of the ornamental group irrigates, compared to 38% for boxwood and 27% for native plant-native collected plant, the other two large classes of nurseries. (In referring to a "group" such as ornamental nurseries, we include those who grow ornamental stock alone or in combination with other kinds, according to the classifications used in Certified Nurseries. Also we have included in the ornamental group two nurseries listed by Certified Nurseries as "general.") Also, ornamentals account for over 60% of the responding irrigators, while no other group accounts for as much as 15%.

Sources of water.--Among our respondents 33% report using ponds as sources of water, 26% streams, and 37% wells--either separately or in combination. The remaining 4% (two nurseries) use public water supplies. Most of the ponds are of the continuous flow type.

The pond and stream sources are distributed generally throughout the state. Well sources are about evenly divided between East and Piedmont; but most of the Piedmont wells are supplementary sources; and most of the large well sources are Eastern. Two medium-sized Piedmont nurserymen reported being about to switch from wells to ponds.

Expansion plans and legal matters.--None of the responding nurseries reported having acquired any water rights or having been involved in litigation or disputes over water rights. No serious dissatisfaction with present water laws was mentioned. An occasional response showed some interest in these matters, however, or indicated some concern over

possible hazards such as lowering of ground water tables by large water users.

One respondent expressed support for a study of water law looking toward a policy of allowing reasonable water use by others but protecting the investments or use of existing water users--a policy guide for the courts favorable to maximum use for all, with protection for all.

Less than one-fifth of the respondents expressed any current intention or need to expand water sources for increased irrigation. Most of these felt that they could meet their needs from sources at hand, or in the words of one nurseryman, "no problem with water--just money." One irrigator noted a need for more ponds but inadequate room for them and mentioned sharing a neighbor's pond in dry periods. One large nurseryman in a populous area said he expected to expand and expected a lot of problems.

With regard to general growth potential, there is one factor at work now which could spur substantial early expansion of nurseries: the natural beautification movement.

A considerable increase in the rate of ornamental tree and shrub planting along roads and in other public places is clearly within the realm of possibility. Since large nurseries may well supply an important part of such plantings, and since large ornamental nurseries are (by the findings of this Paper) the principal irrigators among our nurserymen, the natural beautification program obviously is capable of stimulating a significant growth in nursery irrigation.

Particular nurseries.--Two individual nursery irrigation plants of unusual interest are described in the section on "Special Situations."

TABLE 1

NURSERIES OVER ONE ACRE IN SIZE
IRRIGATORS: BY SIZE, TYPE AND LOCATION

Note: (1) This table covers 33 irrigators--69% of the 48 nursery establishments larger than one acre responding to this survey. (2) As used here, the term "irrigators" excludes nurseries irrigating very rarely or in minimal amounts, as well as those never irrigating.

CATEGORIES	PERCENTAGE OF IRRIGATORS (ESTABLISHMENTS)
Size	
% of irrigators among:	
Medium-size nurseries (1-19 acres)	57%
Large nurseries (20 acres or more)	82
Location	
% of responding nurserymen who irrigate:	
West (includes westernmost Piedmont counties)	45%
Piedmont	87
East	79
% of total number of irrigators located in:	
West	25%
Piedmont	41
East	34
Type	
% of irrigators classified as:	
Ornamental (includes two classed as "general")	62%
Forest seedling and multiflora rose	14
Other categories (beach grass; strawberries; field bulbous and cut flowers; shrub lespedeza; native plant; native collected plant; boxwood; azalea-camellia; combinations of four or more types) totalling:	24

TABLE 2

NURSERIES LARGER THAN ONE ACRE
NON-IRRIGATORS: BY SIZE, TYPE AND LOCATION

Note: (1) This table covers 15 non-irrigators--31% of the 48 nursery establishments larger than one acre responding to this survey. (2) As used here, the term "non-irrigators" includes nurseries irrigating very rarely or in minimal amounts, as well as those never irrigating.

CATEGORIES	PERCENTAGE OF NON-IRRIGATORS (ESTABLISHMENTS)
Size	
% of non-irrigators among:	
Medium-size nurseries (1-19 acres)	43%
Large nurseries (20 acres or more)	18
Location	
% of responding nurserymen who do not irrigate:	
West (includes westernmost Piedmont counties)	55%
Piedmont	13
East	21
% of total number of non-irrigators located in:	
West	67%
Piedmont	13
East	20
Type	
% of non-irrigators classified as:	
Native plant and/or native collected plant*	13%
Combinations that include native plant or native collected plant	53
Ornamental**	13
Combinations that include ornamental	33
Boxwood***	7
Combinations that include boxwood	40
Field bulbous or gladiolus	20

(Totals exceed 100% because of overlapping combinations)

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*The percentage of responding nurserymen who grow native plants or native collected plants, alone or in combination with other stock, and who do not irrigate is 73%.

**The percentage of responding nurserymen who grow ornamental stock, alone or in combination with other stock, and who do not irrigate is 23%.

***The percentage of responding nurserymen who grow boxwood, alone or in combination with other stock, and who do not irrigate is 62%.

Establishments, one acre or less in size

In addition to the larger nurseries, we sent questionnaires to 36 small establishments (one acre or less in size) which are listed as "nurseries" in Certified Nurseries. 14 questionnaires, or almost 40%, were answered.

The majority of these small establishments do not irrigate at all, but depend entirely on natural rainfall. Out of the 14 responses, six owners reported a limited amount of hose watering. Two of these six use city water, while one each uses a pond, spring, stream or well as the source of water. None of the responses specifically indicated use of a fixed irrigation system.

Judging from the answers to our questionnaires, it seems unlikely that these numerous small "nurseries" represent a significant item to be considered in evaluating nursery irrigation in North Carolina on a state-wide basis. It should be emphasized, however, that the size of our questionnaire sample for these establishments was quite limited. Therefore, we would not feel justified in drawing any extensive conclusions from this data. We would not care to assume on the basis of this data, for example, that concentrations of small nurseries may not in localized areas use perceptible quantities of water for irrigation.

Special Situations

Previous UNC Water Resource Papers concerning irrigation embodied county-wide surveys in sample counties, while the preceding sections of this Paper have dealt with irrigation of selected crops. In addition to these two categories of surveys, we felt it would be useful to examine a third category: certain large or otherwise exceptional irrigators. It was our hope that this would develop some useful information on such matters as the advantages or disadvantages of scale, and innovations not likely to be practiced by the average irrigator. Moreover, we felt that an analysis of these large-scale operations might offer some hints on potential development of irrigation in North Carolina within current planning horizons.

The farms included in the "special situation" category were not chosen by any rigorous method of selection. Most of the choices

were based on informal discussions with Agricultural Extension and Soil Conservation personnel. The remainder were gleaned from suggestions derived from our early field studies.

The large or otherwise exceptional irrigators covered by this section of the monograph are as follows:

*The two largest irrigators encountered in our surveys--Eastern Dehydrating Co. (a Davidson County alfalfa and silage irrigator of over 1,250 acres), and Caledonia Prison Farm (a Halifax County truck crop irrigator of 700 or more acres).

*Gold Leaf Farm, the Nash County farm of an early leader in tobacco irrigation.

*The McNair Farms of Scotland and Robeson Counties, owners of McNair Seed Co., and irrigators of 300-400 acres of tobacco and corn.

*Biltmore Dairy Farm in Buncombe County, which irrigates 110 acres of alfalfa and grass.

*Gilmore Plant and Bulb Co., a large nursery and bulb grower of Randolph County, irrigators of 130 acres.

*Laurel Lake Gardens, nursery irrigation innovators in Sampson County.

*George Spayd of Pender County, irrigator of 45 acres of blueberries.

*Colvard Farm of Ashe County, large-scale irrigator of potatoes, cabbage and strawberries.

*S. Vernon Stevens, Jr., farmer and cattleman, who irrigates over 50 acres of tobacco and grass at his farm near the Lee-Harnett county line.

*Cataloochee Ski Slopes of Maggie Valley, one of several western North Carolina skiing resorts which use irrigation-type equipment for artificial snow making.

*A number of other large-scale irrigators scattered throughout the state whose operations are briefly noted.

Eastern Dehydrating Co. (Davidson County)

This concern is a successor to Coble Dairy Co. at a large farm and processing plant in Davidson County near Lexington. The company owns or

leases about 2,500 acres, over half of which is irrigated (approximately 400 acres in corn and 950 in alfalfa). To our knowledge this 1,350 acres is the largest irrigated land holding in the state under a single ownership or management.

Eastern's basic irrigating equipment consists of fixed underground mains and laterals. This equipment was reputedly purchased at a price of several hundred thousand dollars by Coble Dairy Co.

Eastern grows alfalfa and silage for several purposes. Part of the crop is fed to cattle on the premises; the output takes the form both of beef and of fertilizer produced by the cattle and dried for marketing by Eastern. (Eastern is a thoroughgoing water consumer, since it irrigates at one end of the process and removes the last drop of moisture from the other end.) Another part of the crop is dried and processed by Eastern for a poultry feed ingredient.

The irrigation system can cover 65 acres at a setting and is usually operated for twelve hours at a time in order to apply three inches of water. High Rock Lake, bordering one end of the farm, is the major source of water. Ponds serve as an additional source. The status of Eastern's use of water from High Rock Lake is not completely clear. We were unable to determine to our satisfaction whether anything more than tacit acquiescence by the lake owner is involved.

Whatever the circumstances of the original acquisition, the current management of Eastern indicates that no irrigation system comparable to this one would be purchased today for use in Eastern's business. Certainly no expansion is in prospect. The system is used because it is in place, but the management is not satisfied with the yield on irrigated alfalfa. (This yield is less than twice that of the non-irrigated crop.) The lack of better yields is attributed to soil compaction in this area, which retards development of deep root systems, and thereby hinders plant growth.

Caledonia Prison Farm (Halifax County)

If Eastern Dehydrating Company operates the largest irrigation system in the State, perhaps the largest North Carolina system that currently operates to the general satisfaction of its managers is at the Caledonia Prison Farm. This 7,300 acre farm is located in Halifax

County bordering the Roanoke River. 700 acres were irrigated in 1963 on the following scale:

Crop	Acreage	Number of Times Irrigated	Acre-inches per Irrigation
Garden peas	50	2-3	1
Snap beans	100	2-3	1
Tomatoes	60	2-3	1
Sweet potatoes	60	2	2
Sweet corn	200	1	2
Fall beans	150	1-2	1
Turnip greens	50	2	1
Peanuts	30	2	1

The produce of these truck crops is largely sold to the prison cannery, which supplies most of the canned goods for the State's penal institutions. Sales to the cannery average around $100,000 per year, with a usual range of $80-150,000. The farm manager states that he would have had no crop in 1963 without irrigation. Without an available crop, he says, the cannery suffers an overhead loss of about $80,000. From these figures it seems apparent that the irrigation system has produced substantial benefits for the farm and cannery. Against these benefits the original investment in the system was approximately $90,000. The equipment includes three 10-acre systems which can irrigate up to 60 acres per day.

The farm's source of irrigation water is Roanoke River. A permanent pumping station capable of delivering 3,500 gpm is located in the river, with an underwater intake pipe. The water is delivered from the river to a concrete basin at the head of a four-mile canal. The canal, which doubles as a drainage ditch, runs through the fields and thence back to the river. By closing the ditch at a number of points it is possible to provide irrigation reservoirs.

It has often been generalized that only sprinkler-type irrigation is practical in the Southeast because of terrain and soil conditions. An unusual feature of the Caledonia Farm is that it, along with some other farms we encountered in Northeastern North Carolina, is an exception to this generalization. In 1963 furrow irrigation was used successfully on 20 acres, and the success of this irrigation indicated possible expansion. The farm manager estimates that 1,000 acres of the

farm might ultimately be susceptible to furrow irrigation. Plans have also been made for experimental subsurface irrigation by forcing water back into subsurface drainage pipes.

Furrow irrigation is accomplished by laying gated pipe across the upper end of furrows in fields graded to facilitate movement down the furrows. This water supply can also be conveyed in ditches, with siphon tubes used to move the water from the ditch to the furrow. Operating costs for furrow irrigation are less than for sprinkler irrigation. However the initial cost for land grading may be higher than for purchasing sprinkler irrigation equipment. The amount of soil that must be moved and the soil type will determine the practicality of furrow irrigation. Land surveying and grading costs should not exceed $100 to $125 per acre to make furrow irrigation practical. More water will be required for furrow irrigation than for sprinkler irrigation. Care must be taken to avoid overwetting the upper end of the furrow at the expense of not properly irrigating the lower end of the furrow. Annual reshaping of the land is necessary to maintain the precision grade. The acreage of land in eastern North Carolina that is suitable for furrow irrigation is limited.

The extent to which Caledonia Farm can reasonably be used for projecting irrigation development elsewhere is not clear. The unique labor force feature is of course an obvious distinguishing factor from the usual farm. Possibly more significant is the guaranteed market furnished by the cannery, substantially eliminating the risk element from the irrigation investment. It may be that these and other unusual aspects of the Caledonia experience preclude legitimate comparisons with other more commonplace farming situations. On the other hand, it could conceivably prove that other features of the Caledonia experience, such as the scale of operation, were more important for purposes of long-range projection. If scale of operation were to prove the decisive factor in irrigation projections, for example, the extension of large-scale farming in eastern North Carolina might pave the way for major growth in irrigation in that part of the State.

Gold Leaf Farm (Nash County)

Gold Leaf Farm, owned by former State Senator C. S. (Settle) Bunn and his sons, is 900 acres of cropland and woodland in Nash County near Spring Hope. Senator Bunn is a dairy and tobacco farmer, and has been a leading practitioner and spokesman of irrigation since the early 1950's. His farm was perhaps the area's first to irrigate, beginning in 1952. Since then it has been irrigated two or three times every year, except when timely rains made this unnecessary in 1961 and 1962.

Approximately 550 acres were under cultivation at Gold Leaf in 1963. This included 50 acres of pasture and 37 acres of tobacco, plus 460 acres of feed crops to meet the needs of the farm's 200 head of dairy cattle. Only the tobacco, and occasionally the corn in very dry spells, are irrigated.

At Gold Leaf the tobacco plant beds are always irrigated shortly before the plants are removed for transplanting. This is done to avoid root damage. The tobacco is also irrigated shortly after (the same day or the day following transplanting) to insure a high percentage of livability. Senator Bunn states that his farm records show irrigation as raising his annual tobacco income from $150 to $300 per acre, against a cost of only $30-40 per acre (now that his equipment is depreciated and his water sources are established).

Water for irrigation comes from four excavated ponds, two surface ponds and the nearby Tar River. In the early 1950's the Tar River was the principal source but now it is used only in extremely dry weather (as in 1963, when the surface ponds were pumped dry). The shift away from the Tar River as a source of irrigation water was prompted by two factors: water rights questions, and plant diseases transmitted by river water.

Senator Bunn was a member of the General Assembly in 1955, when major changes in water rights laws were last considered. Upon the failure of proposals for drastic overhaul of water rights law, he sponsored the compromise measure that was enacted that year, creating a study agency with limited emergency allocation powers (the State Board of Water Commissioners).

When asked why more farmers do not irrigate tobacco, Senator Bunn was of the opinion that the heavy initial investment was a deterrent, especially for farms with small tobacco allotments. He believes that when the plant food and water needs of crops have been clearly identified by agricultural scientists, this will be a big spur for irrigation. At that point irrigation will no longer merely be a form of drought insurance but will become a general farming practice for quality improvement of crops.

McNair Farms (Scotland and Robeson Counties)

The McNair Farms located in Scotland and Robeson Counties are a diversified farming operation--including tobacco, corn and hay, as well as turkeys, hogs and cattle--which covers nearly 15,000 acres. Associated with the farms are the McNair Seed Company, promoter of the well-known McNair hybrid corn and tobacco seeds, and a dehydration plant that processes cow manure.

McNair Farms began irrigating in 1953 and by 1963 had six systems capable of irrigating 20 acres per setting. 300 to 400 acres of corn and tobacco have been irrigated in dry seasons, with preference to the 100-acre tobacco production. Dug ponds and stream-fed mill ponds are the main sources of water. Irrigation is not a consistent practice but only supplemental to rainfall. Thus there was no irrigation in 1961, a year of ample rainfall, and no corn irrigation in 1962.

The unusual physical arrangements for irrigation at "McBride Farm" in Scotland County, one of the McNair Farms, deserve a word. Water from Shoehill Creek is diverted into a canal at a bend in the stream. Streamflow forces the water 150 feet up the canal, and the water is thence pumped one-half mile to a dug pond. A canal extends from this pond another 300 yards into the field and water is pumped from it for irrigation. Two small fields between the pond and the creek canal were also accessible to the mainline.

Biltmore Dairy (Buncombe County)

The Biltmore Dairy Farm of Buncombe County is another of the State's larger individual farm holdings with a total of 5,250 acres. This farm makes a practice of irrigating its bottomland alfalfa and orchard grass

crops, aggregating 110 acres. These are irrigated continually in dry periods by a 1,200 gpm system. The water sources are the French Broad River and ponds on the farm.

Another of the larger western North Carolina irrigated farms is located in Transylvania County--a 200 acre gladiolus farm which irrigates 50 acres regularly during its June to October season. A $35,000 irrigation system draws on the French Broad River.

Gilmore Plant and Bulb Co. (Randolph County)

One of the largest nursery operations in the State, Gilmore Plant and Bulb Company, grows about 150 acres of ornamental nursery stock, 50 acres of glads and dahlias for bulbs, and four acres (incidentally) of tobacco. Most of the acreage is located near Liberty, about seven miles from the Company's office at Julian. Two acres of seedbeds are laid out at the office site. There is no early prospect for substantial expansion of Gilmore's operations.

Irrigation is essential for growing nursery seedlings, as every amateur gardener well knows, and also for growing flowers and bulbs. For ornamental stock the importance of irrigation depends upon the variety of plant.

Irrigation has been practiced by Gilmore to some extent since the concern went into business forty or fifty years ago. All of the Gilmore flower and bulb acreage is irrigated, as well as the four acres of tobacco and seedbeds. About half of the ornamental nursery stock is covered by irrigation each year. Sources of water for the seedbeds are two nearby continuous flow ponds. Two large continuous flow ponds supply the large Liberty acreage. In order to conserve pipe, water is pumped from the large ponds to several excavated sites, then re-pumped to the further reaches of the farm.

Laurel Lake Gardens (Sampson County)

Another nursery operation of exceptional interest is Laurel Lake Gardens, laid out on a tract of about 30 acres in Sampson County. A conventional portable irrigation system is used for large plants, but cuttings and seedlings are watered by a unique arrangement. The growing boxes, shaded by young pines, contain permanent sprinklers operated by automatic timers. The sprinklers are set for a mist spray and may be

operated for as little as one second six times a minute. A large initial capital expense has been offset by savings on plants, losses in beds having been cut to under 1%. Many nurserymen have visited Laurel Lake to view this innovation.

Water source for this nursery is an old mill pond fed by streams, which has abundantly met irrigation needs with low pumping cost.

George Spayd (Pender County)

One of the established large irrigators of southeastern North Carolina is the George Spayd farm. Spayd irrigates 45 acres of blueberries from dug ponds. His irrigation system has a capacity of 1,500 gpm.

Several other substantial irrigators located nearby in Pender or New Hanover Counties are noted at the end of this section.

Colvard Farm (Ashe County)

Another of the State's largest irrigators is the Colvard Farm in Ashe County. Its very substantial truck crop operations (in 1962) included 125 acres of potatoes, 125 acres of cabbage and 20 acres of strawberries. All of these crops are irrigated from a system which delivers 500 gpm.

Vernon Stevens Farm (Lee and Harnett Counties)

S. Vernon Stevens, Jr. farms and raises beef cattle in the Broadway Community of Lee County. His farm of 450 acres is near the Lee-Harnett County line and lies partly in both counties.

At the time of our initial interview Stevens irrigated about 30 acres of tobacco and 25 acres of bermuda grass two or three times a year at the rate of 1 to 1-1/2 inches of water per setting. When contacted in 1966 he planned to irrigate 15 acres of tobacco and possibly 35 acres of grass in the 1966 season. He began irrigating in the 1953-54 drought and has continued to do so since then, as needed. His farm is on the fringe of the Coastal Plain where the water table is high enough for excavated ponds, and his irrigation water sources include four spring-fed continuous flow ponds and one excavated pond.

Stevens (who also operates a gin and feed business) says that irrigation in his area is limited mainly to the tobacco farmers. About 10-20% of them own irrigation systems, while a few borrow systems. In

his opinion 8 to 10 acres of tobacco is necessary to make a system economic.

As an economy measure Stevens and several neighboring farmers purchased some mainline pipe jointly in a cooperative venture, thereby considerably reducing the amount of capital tied up in pipe. This pipe was available to irrigate fields distant from water sources.

Cataloochee Ski Slopes, Maggie Valley (Jackson County)

An interesting variant of irrigation is practiced in the form of artificial snow-making at several skiing resorts in western North Carolina and eastern Tennessee. Ski slopes that utilize artificial snow are located at Maggie Valley, Blowing Rock and Gatlingburg. We interviewed Mr. Thomas Alexander, the owner of the Maggie Valley operation, Cataloochee Dude Ranch and Ski Slope.

Artificial snow is manufactured by forcing compressed air and water through a special nozzle or gun, a modified form of irrigation equipment. The principle of operation is that the air and water mixture cools very rapidly under favorable temperature conditions, creating condensation, which rapidly makes "snow." Temperatures below 28°F. are required for a better quality of snow, and frozen ground is a prerequisite. The process in use at Cataloochee is patented and thus requires a patent license.

Several factors restrict the number of potential sites for ski slopes. According to Mr. Alexander, in order to permit artificial snow-making sites must be at least 5,000 feet above sea level, must have suitable slopes with a northern exposure, and must be protected from wind. The number of sites meeting these requirements in western North Carolina is limited, especially when further limitations, such as access problems and Federal land holdings, are taken into account. Water is a factor also at higher altitudes, but Cataloochee has had no problems in this regard. A one-quarter acre pond fed by strong mountain springs meets Cataloochee's needs.

At Cataloochee ski slope a water pump and air compressors (leased by the season and quite costly) are located near the pond. Air and water are pumped through underground pipes to a point convenient to the three slopes and thence through two parallel aluminum pipes which run the length of the slope where snow is to be applied. The air-water mixture

is forced as a mist through nozzles attached by rubber hoses to the main lines, to fall to the ground as snow. Each nozzle can take up to 10 gpm, and with 12 nozzles in use at Cataloochee the aggregate rate is 120 gpm. With average operating duration being 36 hours, the average water consumption per run is about 260,000 gallons in order to cover the three slopes. The daily average cost of snow-making in the 1962 season was $3.00 per skier. As regular daily charges to skiers were only $2.50, the operation could make a return only by means of more-than-offsetting revenues from rentals of equipment and facilities.

Two small-scale intensive irrigators

The Jack Finch farm in Nash County and the James Patterson farm in Rowan County offer two examples of small-scale but intensive irrigation.

Since 1958 the Finch farm has irrigated tobacco, peaches and nursery blueberries from wells--about 9 acres, 5-10 acres and one acre, respectively, in 1963. Finch also irrigates a small amount of corn in dry weather. The wells which supply these crops are located near the fields and have always adequately supplied the farm's irrigation needs. During the growing season the one-acre irrigation system is operated continuously.

The Rowan County Patterson farm is located in a heavy concentration of tomato growers in Woodleaf Community. It normally grows nearly 20 acres of tomatoes which are constantly irrigated (if necessary) once a week from late April to late October. Irrigation is used for frost and freeze protection in early spring and late fall. One inch of water per setting is applied until around June 20, and one and one-half inches thereafter. The water sources are continuous flow ponds with occasional reliance on streams. One of the streams occasionally runs low due to upstream irrigation at several points. A pond is shared with a neighbor under a gentleman's agreement; it lies partly on both farms, and no problems have arisen thus far from this joint arrangement. The Patterson farm began irrigating with nine sprinklers in 1945 and now uses 75 sprinklers, which can cover about 6 acres per setting.

Others

It would unduly prolong this Paper to describe in detail all of the relatively large-scale irrigation systems we encountered in our field

surveys. However, it may be informative to list some of the substantial irrigators not previously covered. It should be emphasized that this list (together with the preceding pages) does not purport to cover the entire State of North Carolina. Our previously published county-wide surveys extended to ten counties; we reached another five to ten counties in our field studies. Although it may not be completely comprehensive, this list is intended to include tobacco irrigators with 20 acres or more, and irrigators of other crops with 30 acres or more. The irrigators meeting these specifications but not previously mentioned include:

Alamance County: two tobacco irrigators in the 20-50 acre class.

Buncombe County: two orchard irrigators of 30 acres or more who have substantial expansion potential.

Forsyth County: one 20 acre tobacco irrigator; one 50 acre pasture.

Guilford County: 13 tobacco irrigators in the 20-50 acre class.

Henderson County: one 300-400 acre pasture; one 400 acre truck and one 500-700 acre truck (irrigated over 60 acres); five truck farms in the 100-200 acre class.

Mecklenburg County: one 40 acre pasture, alfalfa irrigator. (Note: this was not a comprehensive county-wide survey.)

New Hanover and Pender Counties: seven growers of gladiolus or other bulbs on 30 acres or more, including three with 75 acres or more.

Pasquotank County: one truck farmer who has at times irrigated 70 acres of an 800 acre farm.

Rockingham County: 19 tobacco irrigators in the 20-50 acre class and one 76 acre tobacco irrigator. (Note: our survey covered only one-eighth of this county's irrigators.)

Scotland County: one 60 acre tobacco and one 25 acre tobacco irrigator. (Note: this was not a comprehensive county survey.)

Surry County: one 55 acre tobacco irrigator. (Note: this was not a comprehensive county survey.)

Warren County: three irrigators with 20-50 acres of tobacco plus irrigated pasture or truck acreage.

Effect of Phosphate Mining in the Pamlico Region on Nearby Irrigation Wells

A major phosphate mining and processing operation has recently been launched in the Pamlico Region of North Carolina. The Texas Gulf Sulphur Company has already established a large open pit phosphate mine near Aurora in Beaufort County, and there are prospects for additional projects in the area. This mine alone withdraws over 60 mgd of water from ground water aquifers, for the dual purpose of supplying process water and reducing artesian pressure in the underlying Castle Hayne ground water aquifer to facilitate mining. (Estimated potential daily withdrawals at the Aurora mine have ranged as high as 100 mgd.)

In another Water Resource Paper to be issued later in 1966 we hope to explore the background of this significant Pamlico development in greater detail. At this point we will focus on a single aspect: the impact of the large ground water withdrawals at the Texas Gulf Sulphur Mine upon neighboring irrigators who rely on wells.[2] We include this account here because this represents the leading example known to us of a current water use conflict involving irrigators.

Within a radius of approximately two to fifteen miles of the mine (and possibly as far as 25 miles), there are about 80 irrigation wells which reportedly have been affected by the water withdrawals at the mine. In essence, ground water pressure has been reduced by the mine's water withdrawals, so that vacuum pumps previously used by the irrigators could no longer draw water. Reportedly, since the coming of the mine, ground water pressures have been lowered by amounts ranging from 5 feet in remotely affected wells to 30-60 feet in wells closer to the mine. As a result, water which previously flowed from artesian wells or could be pumped by vacuum pumps can now be reached only by other and more expensive pumping systems.

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[2] Our principal sources of information for this section were newspaper accounts in the Raleigh News and Observer; a conversation with John Winfield of the N. C. Department of Agriculture (an early spokesman for the affected irrigators); and correspondence with W. B. Thompson of Aurora, head of a committee representing the irrigators in negotiations with Texas Gulf Sulphur Company. Officials of Texas Gulf Sulphur were kind enough to review a draft of this section. None of the aforementioned, of course, is responsible for the contents of this section.

The main irrigated crop locally is potatoes. (Indeed potato irrigation in this area was one of the earliest successful commercial irrigation ventures in the State.) Other irrigated crops may in some instances include tobacco beds, tobacco, cabbage, pasture and corn. Irrigation here may begin as early as March 15 and end as late as July 31, with several weeks around May 1 being an especially important period for irrigating potatoes.

Although as many as 80 irrigation wells may be affected by the mine, not all of these systems are in active use.[3] About 20 of the irrigation systems are said to have been used in 1965. Newspaper accounts indicate that a committee of local citizens bargaining with Texas Gulf Sulphur on behalf of the farmers represented approximately 45 irrigators using 60 wells. These irrigators represent a small proportion of the total number of farmers in the area.

Farm extension personnel and spokesmen for the farmers advised us that alternative water sources for the affected well irrigators are very limited, because of the typically brackish condition of many surface waters in the area. We were given an estimate that only about 3% of the irrigators are in a position to utilize alternative water sources.

A company spokesman suggested to us that there may be several possible alternative sources including dug ponds or shallow wells, especially for small acreages. He also suggested that small surface streams could be tapped by installing one-way valves in culverts to allow runoff waters to escape into the brackish larger rivers but preventing backflow of the brackish waters. He conceded, however, that over-all irrigation costs might be higher with these alternate sources than with a Castle Hayne well.

We were advised that, because of the cost of pumping water, there is little prospect now for expansion of irrigation in this area, either by existing irrigators or by the entry of new irrigators. In addition, the potato acreage (the principal irrigated crop of the area) has been declining in recent years, although the growers remaining in business are the more substantial ones who are more likely to practice irrigation.

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[3] In saying that certain wells were affected by the mine, we do not attempt to evaluate the importance or the economics of irrigation for the crops involved.

The effects of the mine have been felt by irrigators since the 1965 farming season, and negotiations between the Company and the irrigators began in mid-1965. In early 1966 a bargaining committee was appointed to speak for the farmers in negotiations with the Company. A settlement was achieved in March 1966, under which the Company agreed to reimburse over a period of five years the cost of renovating the active irrigation systems. More specifically, it was agreed that the farmers would be repaid in five annual installments over a five-year period, without interest, for systems approved by the Company. Initial installation outlays would be made by the farmers. The aim of the agreement is to enable these irrigators to continue to obtain the volumes of water previously obtained. A company spokesman advised us that operating costs on the converted wells are lower, as a result of a shift to electric power on most of the wells. Electric-powered deep well pumps have the disadvantage of being stationary, however, in contrast to mobile gasoline-driven suction pumps.

We have been told that the total cost of the settlement to the Company is likely to be in the neighborhood of $125,000. (Newspaper accounts report that the Company has previously paid larger sums to install new pumps or wells for home owners and public water supplies in Beaufort County.) It is the Company's position that it has no legal liability to the irrigators, and that the settlement represents a voluntary gesture of neighborly good will.

Amount of Water Use

In a previous paper in this series (U.N.C. Water Resource Paper No. 2) some estimates of water use furnished by the Department of Biological and Agricultural Engineering at North Carolina State University were set forth. Combining those estimates with additional data derived in the course of the current survey, we offer the following approximations of water use by irrigation in North Carolina:

Tobacco--3 to 6 acre-inches per year (recommended minimum design standards for ponds, 12 acre-inches of water per acre of tobacco).

Flowers--Eastern: .2 to .3 acre-inches per day for crop cooling, May through September. Western: approximately 12 acre-inches per year.

Blueberries and strawberries--10 to 12 acre-inches per year.

Alfalfa, pasture and other hay crops--12 to 15 acre-inches per year (recommended minimum design for water source, 18 acre-inches of water per acre of cropland).

Truck crops--Variable, depending on area of State, number of crops grown per year, and other factors. Previous estimates of average water usage were 6 to 8 acre-inches per year. Estimates received in this survey for Caledonia Prison Farm were lower than the averages previously quoted, the Caledonia estimates being 1 1/2 acre-inches to 4 acre-inches per year. By contrast, estimates for one Piedmont tomato farm were considerably higher than the previously reported averages. These tomato farm estimates were 1 acre-inch to 1 1/2 acre-inches per week for a period of conceivably as long as 25 weeks--possibly (though not likely) as high as 3 acre-feet per year.

Turf (e.g., golf courses, lawns, and cemeteries)--Golf courses will probably average 18 to 24 acre-inches per year for tees and greens, 12 to 18 acre-inches per year for fairways. (Probably about one-fourth of the golf courses will irrigate fairways.)

Corn, cotton and peanuts--Corn, 2-4 inches per year; cotton and peanuts, 3-6 inches per year.

Apple orchards--2 to 9 acre-inches per year, western.

Nurseries--Previous estimates, 18 to 24 acre-inches per year. In the current survey a variety of nursery estimates were received. On the low side were figures such as 1/4 acre-inch per year for forest seedlings, and 4 to 5 acre-inches per year for azaleas and ornamental shrubs generally. Some nurserymen indicated they irrigated in minimal amounts, as for seedbeds only, or in setting out plants.

Most of the estimates received were on a daily or weekly basis "as needed," or "during dry weather." Occasionally, more precise indications were received--such as two to three weekly waterings

for container plants when needed (one figure of 50 annual waterings was received); or 4 to 20 yearly waterings for field plants. Precise water use estimates given on a daily basis ranged from 1/8 of an inch to 2 inches per setting. On a weekly basis precise figures received were generally in the 1-2 inch range.

Irrigation Permits

One of the subjects explored in the 1963 field studies was the operation of North Carolina's 1951 Irrigation Permit Law. Before considering the results of the field investigation it will be helpful to review the history of the permit legislation.

The Irrigation Permit Law was enacted in 1951 and remained on the statute books until 1961 when it was repealed. It required persons using water for irrigation from a stream or lake "in such amounts as to substantially reduce the volume or flow thereof" to apply for an irrigation permit and to file with the application a proposed irrigation plan and survey.[4] From the beginning this law proved difficult to administer because of an ambiguous text. Irrigators covered by the statute could not be readily identified because of the vague requirement that application be filed only by irrigators who substantially reduce water flows or quantities. The statutory standards for evaluating permit applications were also unclear. While the administrator was authorized to investigate irrigation plans "as to safety and public interest," he was not explicitly empowered to apply these factors as a test in considering applications.

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[4] SL 1951, Chapter 1049, formerly codified as G.S. 143-355(c). The full text of the statute was as follows: "Any person, firm, or corporation utilizing waters of North Carolina taken from the streams, rivers, creeks, or lakes of the State in such an amount as to substantially reduce the volume or flow thereof for the purpose of irrigation shall before utilizing this resource in this manner make application to the director of the Department of Conservation and Development for a permit for such use. Such person, firm, or corporation shall file with the Department of Conservation and Development a proposed irrigation plan and survey. The director of Conservation and Development is hereby authorized to investigate such a plan as to safety and public interest and to approve plans and specifications and issue permits."

Moreover, he was not explicitly empowered to deny permits. Finally--for cases where a permit was denied or an irrigator subject to the law failed to file--the law contained no expressed sanctions to apply to these violations.

These technical deficiencies in the statute masked a potentially more troublesome legal question: whether North Carolina, a riparian rights jurisdiction, could constitutionally regulate the use of water in this fashion. Doubts concerning the constitutionality of the statute were expressed by the State Attorney General's staff and by other lawyers.

The permit law was administered in the Department of Conservation and Development until 1959, when this responsibility along with other water resource functions was transferred to the Department of Water Resources created that year.[5] In reviewing its responsibilities under this law the new Department found that almost one thousand irrigation permits had been issued by its predecessor. On some streams, it was discovered, permits had been issued covering potential water withdrawals that exceeded known low water flows. Troubled by its findings and by the technical shortcomings of the statute, the Department of Water Resources decided to suspend further issuance of permits. However, unknown to the Department, the Farmers' Home Administration (FHA) had adopted regulations which required that farmers applying for FHA irrigation equipment loans must show compliance with applicable state permit laws. Thus the Department was soon confronted with complaints from farmers whose irrigation loans were stalled by the new departmental policy. Following consultation with FHA the Department instituted a stop-gap practice of issuing letters to applicants for permits indicating its views concerning the application, without formally either granting or denying permits.

After further consideration the Department concluded that the permit law was unworkable in its existing form, and recommended repeal as the best way to clear the air and to lay a foundation for a better eventual solution of water use conflicts. Accepting this recommendation the 1961

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[5] SL 1959, Chapter 779.

General Assembly repealed the Irrigation Permit Law, a decade after its enactment.[6]

This repealer brought to an end a limited experiment with statutory regulation of water use by the State of North Carolina--the only substantial modern example of such regulation in this state, aside from the Stream Sanitation Law. The irrigation statute was never tested in the court. Its repeal leaves an unanswered question concerning the validity of legislation in North Carolina of this type, which purports to allocate or regulate the use of water.

The repeal inevitably left another unanswered question: What is the status of permits and letter approvals that were issued while the statute remained on the books? If this law validly created a right of some kind to utilize designated quantities of water for irrigating crops, a farmer who had invested in an irrigation system relying upon a permit might be able to enforce his rights under the permit, notwithstanding repeal of the statute. The significance of these potential claims should not be exaggerated: they could affect a small and diminishing proportion of the state's irrigators, and the prospect of successfully establishing such rights in the courts is hardly bright.

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In connection with the 1963 field studies of this project a special survey was made of a selected group pf permit holders in hopes of shedding additional light on the current expectations of irrigators who did secure permits under the statute before it was repealed. Surry County was chosen for this survey as a representative area with a relatively large number of permits issued at various times during the decade of the 1950's. Official records show a total of 42 permits issued to 34 irrigators in the county. In this survey a random sample of half of these irrigators was selected and contacted.

Each of the irrigators was asked why he had obtained a permit; whether he still retained it; how he regarded the permit (i.e., what rights it gave him); and whether he was aware of the repeal of the permit law. The responses indicated that none of these farmers was apparently

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[6] SL 1961, Chapter 315.

aware of the repeal, and that most of them retained their written permits. About one-third of the farmers stated they had secured permits only to comply with FHA loan requirements. Of those few who expressed views on the nature of the permit, several considered it an allotment similar to their tobacco allotments. One of these regarded it as an interest running with the land which would be transferred upon sale of the farm.

In reviewing the permit records of the Department of Water Resources, we noted that although the 1951 statute specifically required permits only for irrigation from "streams, rivers, creeks, or lakes," permits were issued in some cases also for irrigation from farm pounds apparently fed only by surface drainage or springs. For example, of the 42 permits issued to Surry County irrigators, between ten and fifteen appeared to fall in this category.

To summarize, a diminishing and probably minor proportion of irrigators in North Carolina at one time or another secured permits under the former Irrigation Permit Law. If the field studies we have made in Surry County can be deemed representative, a number of permit holders may yet be unaware of the repeal of the statute and may physically retain their permits, which they probably regard as some form of water allocation or allotment. In light of these findings it would hardly be surprising if at some future day an irrigator seeking to justify his use of water were to bring before the courts or into the legislative halls the questions of constitutionality and of vested rights left open by repeal of the permit law.

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It goes without saying that this report would not have been possible unless the many irrigators whom we contacted had freely given of their time to answer our questions. We hope that the results will be of interest to them.